# Arsenic Removal Technology for Public Water Systems (PWS)

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Public Drinking Water Section

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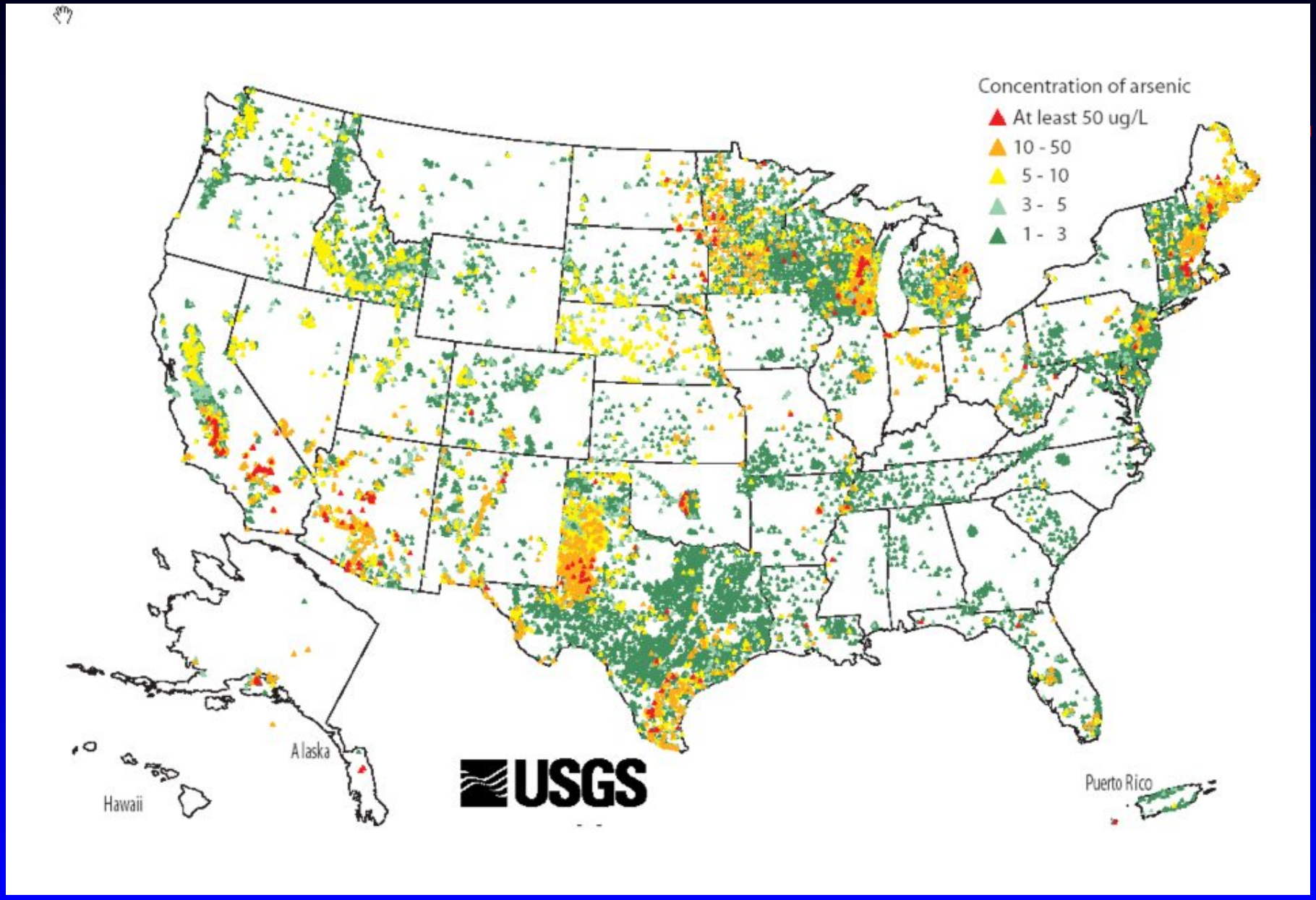
# Outline

- Arsenic occurrence in Texas
- Health effects
- Revised Arsenic Rule
- Treatment options
  - Competitive technologies

# Monitoring

Kristine Krieg

# Concentrations of Arsenic - Wells



# Arsenic in Texas

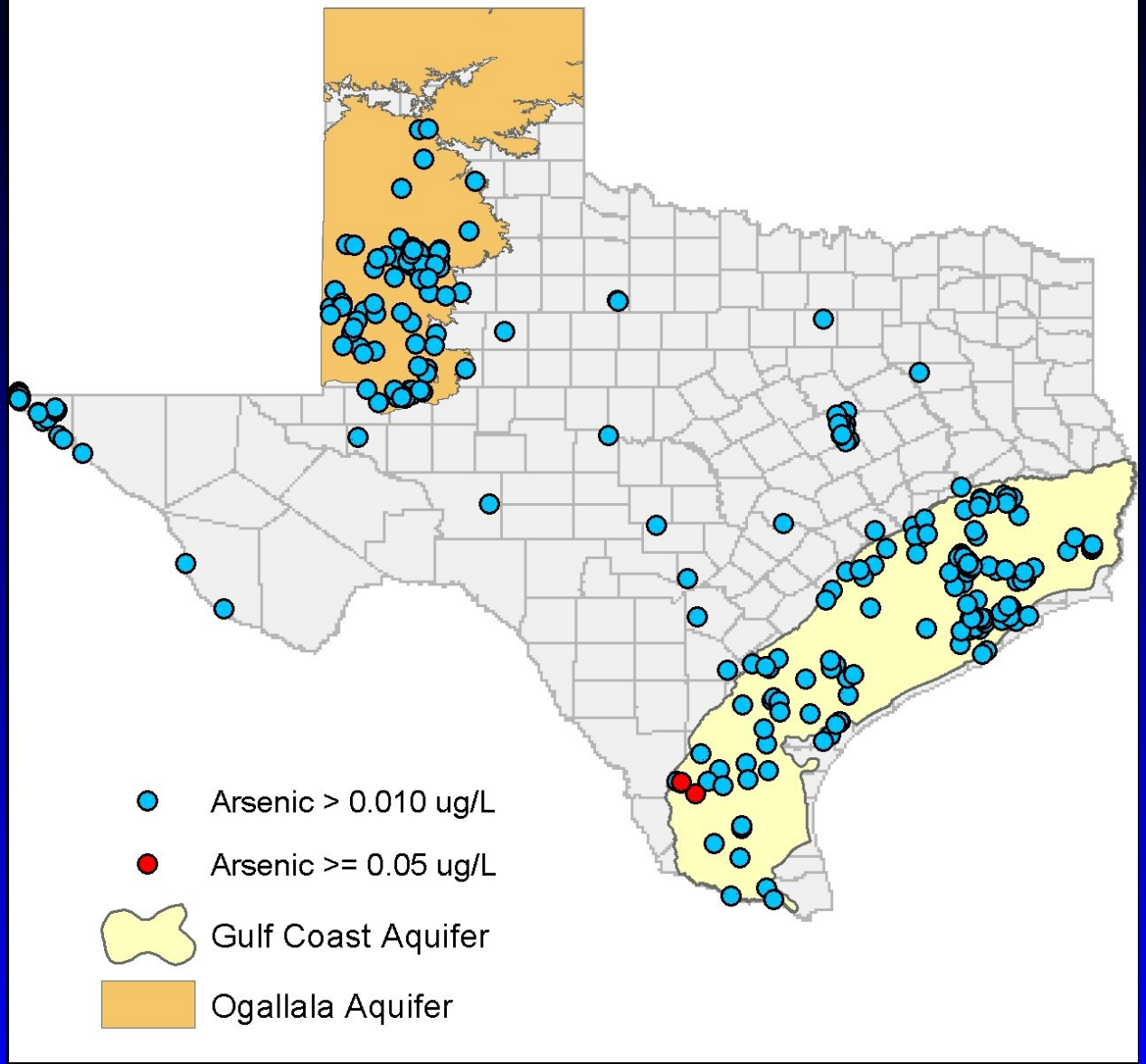
Hueco-Mesilla Bolson

Ogallala Aquifer - Interbedded sand, clay, silt

Gulf Coast Aquifer - Includes the Jasper, Chicot, and Evangeline aquifers. Consists of interbedded clays, sands, silts, and gravels.

- Processes - Arsenic in Ogallala groundwater may be associated with natural uranium mineralization in the High Plains.
- Arsenic in Ogallala and Gulf Coast aquifers may be associated with agriculture.

# Potential Arsenic Violators



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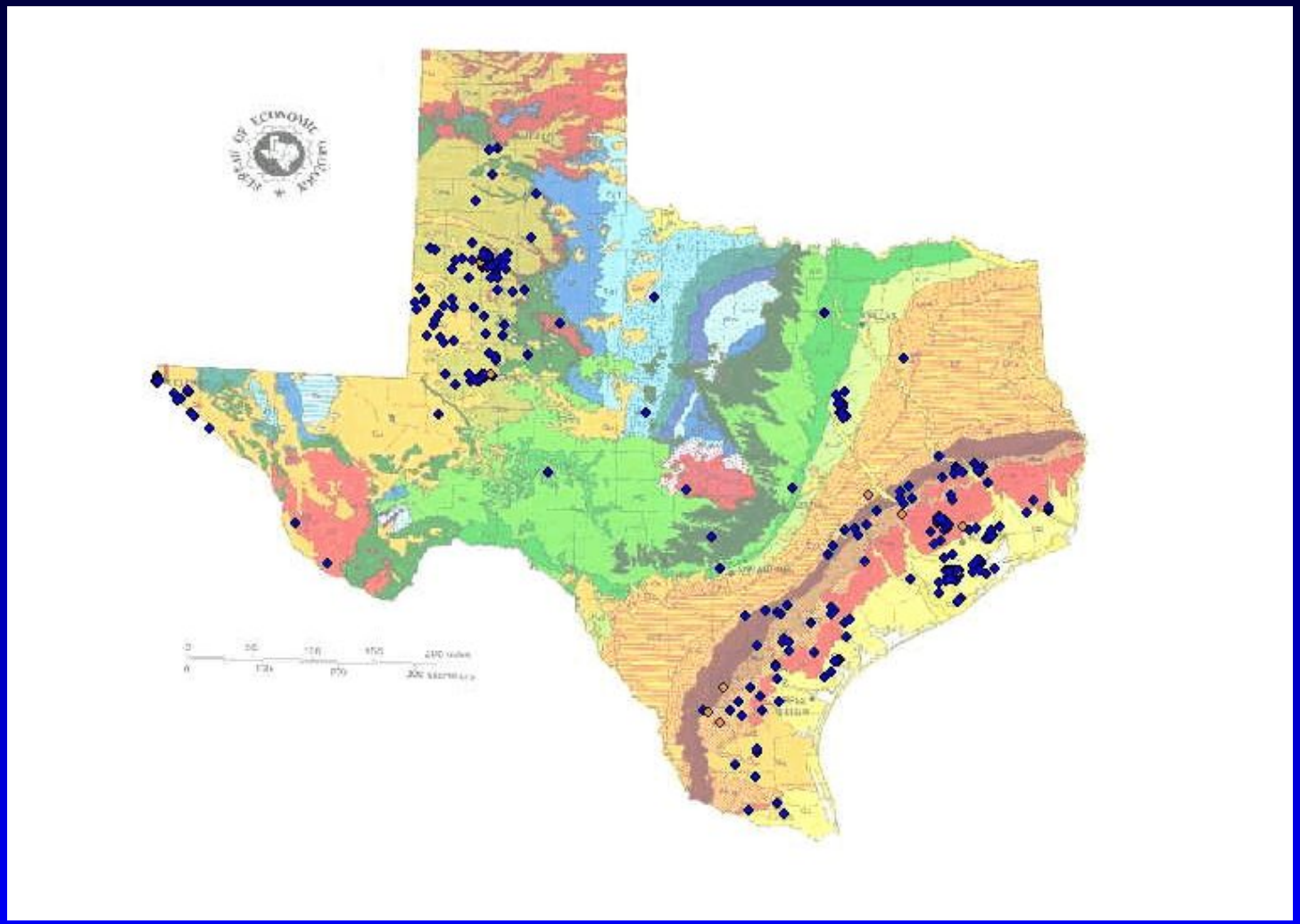

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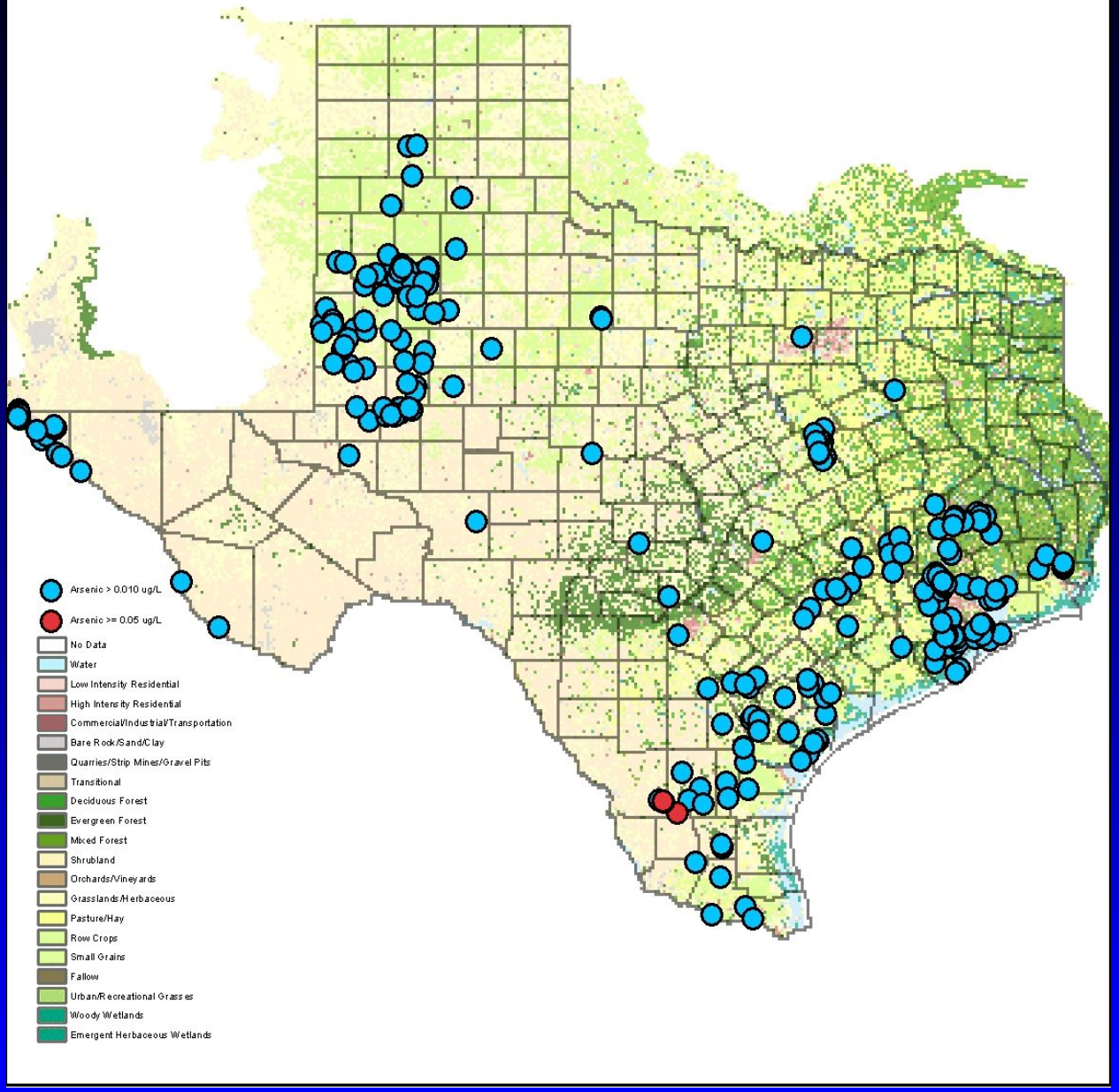


# Sources of Arsenic

- Naturally-occurring element
- Agriculture - insecticides, rat poison, herbicides, wood preservative
- Pigments - paints, ceramics, wallpaper
- Medicine - treatment of syphilis, leukemia, psoriasis

# Arsenic Health Effects

Long-term exposures to high Arsenic levels
(>> 0.05 mg/L) have been linked to:

- Cancers - bladder, lungs, skin, kidneys, nasal passages, liver, and prostate
- Cardiovascular, pulmonary, immunological, and neurological effects

# Arsenic Rule

- Revised arsenic maximum contaminant level (MCL) takes effect January 23, 2006
- Arsenic MCL = 0.010 mg/L (10 ppb)
- Rule applies to all community and non-transient, non-community water systems
- Systems must sample at each entry point to the distribution system

# Arsenic Rule (cont.)

- Ground water systems will be required to sample every three years
- Surface water systems will be required to sample annually
- After initial samples are taken and in compliance, PWS will be eligible for reduced monitoring

# Arsenic Monitoring

- Quarterly sampling must be implemented if arsenic concentration in any sample > MCL
- Compliance is based on a running annual average of the quarterly samples

*30 TAC 290.106(c)(3)(C)*

# Arsenic Monitoring

- After initiation of quarterly sampling, a PWS may be returned to routine arsenic monitoring if quarterly sampling shows that sample results are reliably and consistently < MCL

# When a PWS Exceeds the Arsenic MCL…

- Must provide quarterly public notices to consumers as long as the violation exists
- To resolve the violation, PWS must seek alternative treatment methods or water sources

# Public Notice Language

- This is not an emergency. However, some people who drink water containing arsenic in excess of the MCL over many years could experience skin damage or problems with their circulatory system, and may have an increased risk of getting cancer.

- You do not need to use an alternative water supply. However, if you have health concerns, you may want to talk to your doctor to get more information about how this may affect you.

# Certificate of Delivery of Public Notice

PWS must certify delivery

- Date notice was delivered to customers
- Reporting period (i.e., Quarter 1 2005)
- Signed / dated by system representative

# Treatment Options

Mike Howell

# Chemistry Overview

Solubility of Arsenic species

- As (III)
  - Soluble
- As (V)
  - Insoluble (only when co-precipitated)

# Options

Available Processes

- Abandon problem source, seek alternative
- Blending to reduce levels below MCL
- Side stream treatment - treat a portion of the water then blend with untreated water to reduce levels below MCL
- Full treatment

# Options (cont.)

(~ 95% Removal Efficiency)

- Sorption Treatment Processes
  - Iron-based adsorption media (IBS)
  - Ion exchange (IX)
  - Activated alumina (AA)
- Membrane Treatment Processes
  - Reverse osmosis (RO)

# Options (cont.)

(Removal efficiency %)

- Precipitation / Filtration Processes
  - Coagulation-assisted microfiltration (90%)
  - Enhanced coagulation / filtration
    - w/ Alum (< 90%)
    - w/ Ferric chloride (95%)
  - Enhanced Lime Softening (LS) (90%)
  - Oxidation / Filtration - greensand (50-90%)

# Competitive Technologies

Pros / Cons

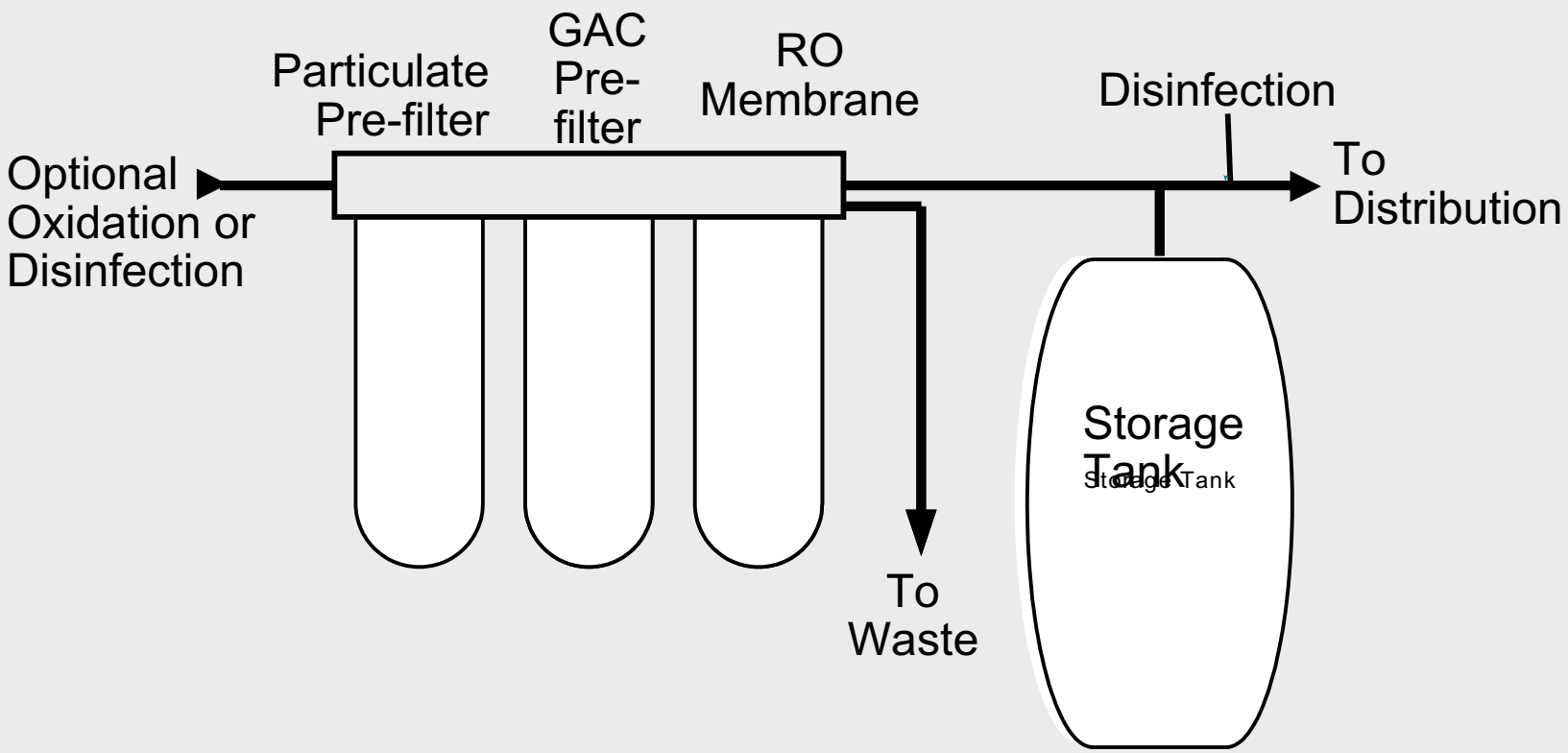
- Adsorption - simple, non-regenerative in most cases
- Coagulation / Microfiltration - effective for Fe / Mn waters
- Reverse Osmosis - effective for TDS removal, less for As (III). Most wasteful, 15-25% water loss

# Competitive Technologies (cont.)

Pros / Cons

- Ion Exchange - good for waters with:
  - High As, pH / Low $SO_4$, $HCO_3$
  - Co-removal $NO_3$ and/or $CrO_4$
  - Requires regeneration / post-treatment, will not remove As (III)
    - Free chlorine converts As (III) to As (V)

# Reverse Osmosis



# Feasibility of Treatment

Treatment costs?

- Factors to consider:
  - Capital required
  - Maintenance
  - Sampling (Arsenic removal effective?)
  - Waste Discharge Permit (fee?)

# Cost per Connection

- Treatment cost example calculations:
  $40,000 for 1,000 conn = $40 / conn

  $10,000 for 50 conn = $200 / conn

  - Message: Start saving now!

# Rate Increase Application

- If Investor-owned Utility
  - Submit rate increase application

*30 TAC 291.31(d)*

# Approval as Innovative Treatment through TCEQ Exception Process

- Exception request is submitted by PWS or its engineer.
- Exceptions are granted to the PWS, not the manufacturer of the treatment unit.

*30 TAC 290.39(l)*

# Plans/Specifications Review and Exception Requests

Submit documents to TCEQ
Public Drinking Water Section (MC-155)

- Plans Review Team (plans / specs)
- Technical Review & Oversight Team (exception request including pilot study report or data from site with similar raw water)

# Permitting for Waste Discharge

Submit waste discharge application to TCEQ or Publicly-Owned Treatment Works (POTW)

- Applicable city ordinances?
- Pre-treatment?
- POTW - each may have different limits and requirements

# Waste Discharge Applications

Spent Media Disposal Options

- Municipal Solid Waste
- Industrial / Hazardous Waste

# Permitting for Waste Discharge

- Contact TCEQ's Industrial/Hazardous Waste team to determine if material is listed as hazwaste

# Point-Of-Use Approval

Submittals to TCEQ for approval of POU or Whole-House Treatment (WHT) need:

- Cost comparison (feasibility study)
- Pilot test results
- 100% customer participation required
- Proof of ANSI / NSF approved devices

*30 TAC 290.106*

# Point-Of-Use Approval (cont.)

POU or Whole-House Treatment (WHT) must have:

- TCEQ-approved sampling plan
- Units owned/maintained by the utility
- Local ordinances defining liability

# POU Sampling Plan

- Ensure every unit is working
- Rotate sample sites
- Compliance samples and field test
- Approved sampling plan

# Is POU / POE the Best Strategy?

- POU or POE must clearly be the best compliance choice for the community
- Financial savings ($ / household) is primary customer incentive
- PWS must be committed to making POU / POE work

# Summary

- Arsenic is naturally occuring in parts of Texas
- Elevated Arsenic concentrations due to mans contributions
- Arsenic regulations have recently been revised
- New regulations will create more violations
- Several compliance options
- Treatment options limited by cost

# Summary (cont.)

- Submit:
  - Exception request with pilot study
  - Plans and specifications
  - Discharge permit application to TCEQ or POTW
- Centralized Arsenic removal vs POU or WHT

# TCEQ Contacts

- Land Application of Sludge
  (512) 239-3410
- Industrial Wastewater
  (512) 239-4671
- Municipal Solid Waste
  (512) 239-2334
- Industrial / Hazardous Waste
  (512) 239-6412

# More Information

Guidance, training, treatment information

- http://www.epa.gov/safewater/arsenic.html
- http://www.www.usgs.gov
- http://www.twdb.state.tx.us
- Potential Arsenic violator maps located at:
- ftp://ftp.tceq.state.tx.us/pub/oprr/swap/

# Assistance


Drinking Water Quality Team

Public Drinking Water Section

(512) 239-4691

http://www.tceq.state.tx.us

# Questions